



JUNE 1998 GROUNDWATER TREATMENT SYSTEM
MONITORING REPORT

AMERICAN CHEMICAL SERVICE NPL SITE
GRIFFITH, INDIANA

Montgomery Watson File No. 1252057

Prepared For:

ACS RD/RA EXECUTIVE COMMITTEE

Prepared By:

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December 1998

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1.0 INTRODUCTION

Montgomery Watson, on behalf of the ACS RD/RA Executive Committee, commenced operation of an on-site groundwater treatment system at the American Chemical Service NPL Site (ACS Site) in Griffith, Indiana on March 13, 1997. This treatment system was designed to treat groundwater from the perimeter groundwater containment system (PGCS) and limited volumes of water from the Barrier Wall Extraction System (BWES). The treated effluent from the treatment system is discharged to the nearby wetlands, west of the treatment system, in accordance with Agency approvals. The treatment consists of a phase separator for oil and free product removal, equalization tanks, a UV-oxidation unit for destruction of organic constituents, an air stripper to remove methylene chloride and other organics, a chemical precipitation and clarification unit to remove metals, a sand filter to remove suspended solids, and activated carbon vessels for final polishing of the treated groundwater.

Although the majority of the treatment system capacity was originally designed to treat PGCS-associated groundwater, the system is also used to treat groundwater from the BWES. The groundwater associated with the BWES typically has higher contaminant concentrations such as COD and BOD₅ than that of the PGCS due to their respective locations on the ACS site. Consequently, modifications to the treatment system are being evaluated to accommodate more of the BWES-related groundwater.

This is the third groundwater effluent monitoring report, and summarizes effluent analytical data and water level gauging collected between December 1997 and June 1998. The first and second quarterly groundwater effluent monitoring reports were submitted to the United States Environmental Protection Agency (U.S. EPA) in October 1997 and January 1998. From December 1997 through June 1998, the groundwater treatment system was operated generally on a continuous basis (other than shut-downs for maintenance) at an influent flowrate between 20 and 35 gpm. The effluent was directly discharged to the wetlands.

2.0 COMPLIANCE MONITORING

2.1 INTRODUCTION

Effluent samples were periodically collected from the treatment system to demonstrate compliance with the discharge limits (Table 2.1) established by IDEM and U.S. EPA. Effluent samples were collected in accordance with the sampling frequency delineated in the Agency approved PSVP, and presented in Table 2.2. Sampling and analyses were performed in accordance with the Agency-approved PSVP Quality Assurance Project Plan (QAPP) prepared by Montgomery Watson for the ACS RD/RA Executive Committee in April 1997. The following paragraphs present details on sampling and analyses, and also summarize the analytical data for the treatment system effluent.

2.2 SAMPLING AND ANALYSES

Effluent samples are collected on a monthly basis. For this reporting period, the samples were collected on the following days:

Monitoring Chronology

Monitoring Period	Sample Date
Month 7	12/23/97
Month 8	1/20/98
Month 9	2/18/98
Month 10	3/23/98
Month 11	4/28/98
Month 12	5/31/98
Month 13	6/24/98

Effluent samples were collected directly from a sample tap on the effluent line just before it exits the groundwater treatment system building. All effluent samples were placed in contaminant-free containers, as specified in the U.S. EPA Specifications and Guidance for Obtaining Contaminant-Free Sample Containers (U.S. EPA, 1992). Appropriate sample containers and preservatives, as specified in the QAPP, were used to collect and preserve the samples. Following sample collection, the sample containers were refrigerated at 4°C in coolers. Chain-of-Custody forms were prepared to track the transfer of samples from the treatment system to the laboratories. Samples were analyzed by the following analytical methods:

- VOCs (Analytical Method: SW-846 8260A)
- SVOCs (Analytical Method: SW-846 8270B)
- Pentachlorophenol (Analytical Method: SW-846 8270B and SIM)
- Pesticides/PCBs (Analytical Method: EPA 608)

- Metals (Excluding Mercury) (Analytical Method: SW 846 6010)
- General Water Quality Parameters (TSS and BOD-5) (Analytical Method: EPA 160.2 and 405.1)
- Mercury (Analytical Method: SW-846 7470)
- pH (Analytical Method: EPA 150.1)

2.3 ANALYTICAL RESULTS

In general, the system effluent was compliant with the discharge limits presented in Table 2.1. Total suspended solids (TSS) and semi-volatile organic compounds were not detected in the system effluent during the period between December 23, 1997 and June 24, 1998. With the exception of the two arsenic exceedences, metals concentrations in the effluent were below the discharge limits during the monitoring period. Methylene chloride and 4-methyl-2-pentanone were detected during this period above discharge limits. A comparison of the analytical data collected during the monitoring period with the discharge limits is presented in Table 2.3. Detailed analytical reports are attached in Appendix A.

During the period of December 23, 1997 through June 24, 1998, the treatment system experienced the following discharge exceedences:

February 18, 1998 Compliance Sample

A BOD₅ concentration of 42 mg/L was recorded for the sample collected on February 18, 1998, above the effluent limit of 30 mg/L. It is possible that on February 18, 1998, particulate matter (insoluble BOD₅) escaped capture in the lamella clarifier and the sand filter and exited the system through the GAC units. Solids removal processes capable of removing solids of < 1 um (micron) size are currently being evaluated. The GAC replacement cycle is being closely monitored to avoid such an occurrence.

The methylene chloride concentration in the February 18, 1998 sample was 7.6 µg/L, above the discharge limit of 5 µg/L. However, this concentration was estimated ("J" qualified by the laboratory), and methylene chloride was also found in the laboratory blank associated with the compliance sample (and therefore "B" qualified by the laboratory) at a concentration of 0.15 µg/L. Given the above information, this exceedence was likely attributed to laboratory artifacts.

March 23, 1998 Compliance Sample

Methylene chloride was detected at 9.8 µg/L in the compliance sample collected on March 23, 1998, above the methylene chloride limit of 5µg/L. This concentration was estimated ("J" flagged by the laboratory). In addition, the laboratory reported a concentration of 32 µg/L (again, "J" flagged) for 4-methyl-2-pentanone. This compound had not been detected in the effluent prior to this date, and has not been detected since. On July 9, 1997, a shallow tray air stripper was installed in the treatment system to strip the methylene chloride from the groundwater prior to discharge. Because methylene chloride is readily strippable, this compound should not be detected in the effluent. Therefore, the laboratory results are questionable. Methylene chloride has not been detected in the effluent since the March compliance sample.

The March 23, 1998 compliance sample to be analyzed for BOD₅ was preserved for an incorrect period of time by the laboratory and therefore the laboratory could not generate a reportable quantity for BOD₅. Therefore, effluent BOD₅ data is unavailable for March 23, 1998. The compliance samples from April, May and June did not contain BOD₅ above the 30 mg/L discharge limit.

May 20 and June 24, 1998 Compliance Samples

The effluent pH measured by the laboratory exceeded the upper pH discharge limit of 9.0 S.U. by 0.2 S.U. on May 20, 1998. However, the on-site pH probe in the discharge pipe recorded that pH was below 9.0 S.U. on May 20, 1998. Because the in-pipe pH probe collects pH data continuously, this real-time data is considered more accurate than the laboratory-measured pH, after the sample has been shipped to the lab and prepared. The effluent pH has not been above 9 or below 6 since May.

Arsenic concentrations of 69 µg/L and 60 µg/L were reported by the laboratory on May 20, 1998 and June 24, 1998, respectively. These concentrations were above the effluent limit of 50 µg/L for arsenic. The removal of arsenic depends on which species of arsenic predominates, the arsenite or arsenate species, and is dependent on the precipitation mechanism employed. pH of the process water effects the efficiency of the arsenic removal. Following these arsenic exceedences, the pH in the lamella clarifier was adjusted to 8.5 S.U. as is consistent with available literature (Patterson 1985) for the efficient removal of arsenic.

Reference

Patterson J.W. "Industrial Wastewater Treatment," Butterworth Publishers, 2nd ed., pp.11-21, 1985.

Table 2.1 Groundwater Treatment System Effluent Discharge Limits
American Chemical Service NPL Site
Griffith, Indiana

Groundwater Quality Parameter	Effluent Standard (Limit)
<i>General Water Quality Parameters</i>	
PH	6 - 9 S.U.
BOD-5	30 mg/L
TSS	30 mg/L
<i>Inorganics</i>	
Arsenic	50 µg/L
Beryllium	NE
Cadmium	4.1 µg/L
Manganese	NE
Mercury	0.02 µg/L (w/DL = 0.64)
Selenium	8.2 µg/L
Thallium	NE
Zinc	411 µg/L
<i>Volatile Organics</i>	
Acetone	6,800 µg/L
Benzene	5 µg/L
2-Butanone	210 µg/L
Chloromethane	NE
1,4 - Dichlorobenzene	NE
1,1 - Dichloroethane	NE
1,2 - Dichloroethene - cis	70 µg/L
Ethylbenzene	34 µg/L
Methylene chloride	5 µg/L
Tetrachloroethene	5 µg/L
Trichloroethene	5 µg/L
Vinyl chloride	2 µg/L
4 - Methyl - 2 - pentanone	15 µg/L
<i>Semi-Volatile Organics</i>	
bis(2 - Chloroethyl) ether	9.6 µg/L
bis(2 - Ethylhexyl) phthalate	6 µg/L
Isophorone	50 µg/L
4 - Methylphenol	34 µg/L
Pentachlorophenol	1 µg/L
<i>PCBs</i>	
PCBs	0.00056 µg/L (w/DL = 0.1)

NE = No effluent limit established.

Table 2.2 Sampling Frequency Scheme
Groundwater Treatment System
American Chemical Service NPL Site
Griffith, Indiana

Analytes	Cumulative Time From Startup*	Frequency
Flowrate and pH	–	Continuous
BOD, TSS, SVOCs and Metals	0 to 7 days	Once per day
	8 to 30 days	Once per week
	31 to 180 days	Once per month
	181 days onward	Once per quarter
VOCs	0 to 7 days	Once per day
	8 to 30 days	Once per week
	31 days onward	Once per month
PCBs	0 to 7 days	Once
	8 to 30 days	Once
	31 to 180 days	Twice
	181 days onward	Once per quarter
PCBs in Sediment (one location)	–	Once per year

- * Cumulative time from startup of the groundwater treatment system. Startup refers to the point at which contaminated groundwater from the extraction trench was being introduced into the treatment system. Startup occurred once the initial equipment/system testing with clean water was completed (March 13, 1997).

Table 2.3 Effluent Analytical Results
Groundwater Treatment System
ACS NPL Site
Griffith, Indiana

Date	Units	12/23/97	1/20/98	2/18/98	3/23/98	4/28/98	5/20/98	6/24/98	Effluent Limits
pH	S.U.	7.1	7	6.7	7.1	8.3	9.2	6.9	6-9
TSS	mg/L	ND	ND	ND	ND	ND	ND	11.5	30
BOD	mg/L	13	ND	42	NA	16	7	20	30
Arsenic	ug/L	5.4 J	6.6 J	ND	ND	27	69	60	50
Beryllium	ug/L	ND	ND	0.49 J	ND	ND	ND	ND	NE
Cadmium	ug/L	ND	ND	ND	ND	ND	ND	ND	4.1
Manganese	ug/L	890	240	740	340	1.5	6 J	32	NE
Mercury	ug/L	ND	ND	ND	ND	ND	ND	ND	0.02
Selenium	ug/L	ND	ND	ND	ND	ND	ND	ND	8.2
Thallium	ug/L	6 JB	4.8 JB	3.9 J	ND	ND	5.3 J	ND	NE
Zinc	ug/L	20	260 B	11 J	7.1 J	ND	13 J	ND	411
Acetone	ug/L	18	ND	3,200	860	ND	ND	6.6 J	6,800
Benzene	ug/L	ND	ND	ND	1.3 J	ND	ND	ND	5
2-Butanone	ug/L	ND	ND	ND	150	ND	ND	ND	210
Chloromethane	ug/L	ND	ND	ND	ND	ND	ND	ND	NE
1,4-Dichlorobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	NE
1,1-Dichloroethane	ug/L	0.16 J	ND	ND	ND	ND	ND	ND	NE
cis-1,2-Dichloroethene	ug/L	ND	ND	ND	1.2 J	ND	ND	ND	70
Ethylbenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	34
Methylene Chloride	ug/L	0.46 J	ND	7.6 JB	9.8 J	ND	ND	ND	5
Tetrachloroethene	ug/L	ND	ND	ND	ND	ND	ND	ND	5
Trichloroethene	ug/L	ND	ND	ND	ND	ND	ND	ND	5
Vinyl Chloride	ug/L	0.3 J	ND	ND	ND	ND	ND	ND	2
4-Methyl-2-pentanone	ug/L	ND	ND	ND	32 J	ND	ND	ND	1
bis(2-Chloroethyl)Ether	ug/L	ND	ND	ND	0.97 J	ND	ND	ND	9.6
bis(2-Ethylhexyl)Phthalate	ug/L	ND	ND	ND	ND	ND	ND	ND	6
Isophorone	ug/L	ND	ND	ND	ND	ND	ND	ND	50
3/4 - Methylphenol	ug/L	ND	ND	ND	ND	ND	ND	ND	34
Pentachlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	1
PCBs	ug/L	BQL	NS	NS	BQL	BQL	NS	NS	0.00055

Notes:

Shaded cells indicate discharge exceedances.

Suffix Definitions:

B = Compound is also detected in the blank.

BQL = Below quantitation limit.

J = Result is detected below the reporting limit and is an estimated concentration.

NE = No effluent limit established

NS = Not required to be sampled

ND = Not Detected

NA = Not Analyzed due to Laboratory Error

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3.0 TREATMENT SYSTEM PROCESS MODIFICATIONS

The groundwater treatment system did not experience the long term operational problems during this quarter. However, a few specific problems such as fouling of the granular activated carbon (GAC) units were encountered. Following paragraphs describe the efforts taken to resolve the GAC units fouling and other process modifications made/evaluated to optimize system operations.

GAC Units Chlorination

Sludge floatation was observed in the lamella clarifier due to the release of oxygen from residual peroxide. Sodium bisulfite was introduced upstream of the lamella in an effort to destroy the excess oxygen. Low DO (Dissolved Oxygen), iron and sulfate downstream of the sand filter resulted in the precipitation of iron sulfides onto the GAC. The GACs became an ideal breeding ground for iron reducing bacteria that caused the GAC units to constantly plug up and result in operational hassles. The plugging of the GAC units became so severe that considerable operational effort had to be expended to frequently backwash the GAC units. A decision was made to eliminate the iron reducing bacteria by chlorinating the groundwater prior to entering the GAC units. Residual chlorine of approximately 2 mg/L was maintained for a two month period and the iron-reducing bacteria were eliminated. Subsequently chlorination was discontinued and the pH of the groundwater was raised to approximately 7.0 S.U. upstream of the GAC units to prevent iron sulfide precipitation. Since these short – term process changes were implemented, similar operational problems have not been experienced.

Coagulant Addition System

A coagulant addition system was installed to deliver coagulant to the rapid mix tank of the lamella clarifier. The purpose of adding coagulant is to enhance solids removal in the lamella. The coagulant will aid in the development of the floc and the polymer addition (previously implemented) will condition the floc and result in better solids removal in the clarifier.

Temporary Cartridge Filter Test Studies

Temporary cartridge filter test studies were conducted to further remove solids less than 1 μm (micron) in size downstream of the sand filter prior to the GAC units. The cartridge filters effectively removed such particulate matter. Particulate matter of 1 μm or less can also aid in plugging the GAC units and cause operational problems. Therefore, other solids removal processes are currently being evaluated.

General Discussion

In general, efforts were made to improve and optimize the performance of the treatment system. GAC adsorption saturation was monitored more closely since the February 18, 1998 compliance-sampling event. Daily measurements of the lead GAC column effluent chemical oxygen demand (COD) were taken to monitor the breakthrough of the organic compound front. Following appearance of the breakthrough, fresh GAC replacement was initiated and completed on a fast track. The precipitation pH in the lamella clarifier was

adjusted to 8.5 S.U. to obtain optimum arsenic precipitation without compromising the precipitation chemistry of the other metals. On March 23, 1998 in addition to conducting the compliance-sampling event, several parameters such as VOCs and SVOCs were measured in the influent and effluent of various treatment units to obtain a better snap shot of the removal/treatment efficiencies of the individual treatment units.

4.0 PGCS AND BWES GAUGING ACTIVITIES

The PGCS trench groundwater extraction wells were operated in "auto" mode (semi-continuously) beginning May 19, 1997. In accordance with the PSVP for the Site, a discussion on the effect of the PGCS and BWES on the water table near the Site is presented in each quarterly monitoring report. This section presents a discussion on the groundwater elevation findings during the months of December 1997 through June 1998. Groundwater elevation measurements were collected throughout the Site on December 8, 1997 and June 1, 1998. Because the long term groundwater monitoring plan was not established during the first six months of 1998, no quarterly sampling event was conducted in the first half of 1998, and therefore groundwater levels from the PGCS piezometers were not collected in January through May, 1998. However, to keep track of the groundwater table inside the barrier wall, levels were collected from the BWES piezometers on March 30, 1998 and from four piezometers within the barrier wall (P-3, P-32, P-49 and P-96) on a weekly basis thereafter. The levels from these four piezometers are shown in the table below.

	Water Table Elevation			
Date	P-3	P-32	P-49	P-96
April 3, 1998	637.12	636.74	636.40	631.97
April 10, 1998	636.87	636.48	636.04	628.59
April 17, 1998	636.37	636.22	635.68	634.99
April 24, 1998	636.97	636.52	636.18	635.99
May 1, 1998	637.17	637.12	636.48	635.19
May 8, 1998	637.57	637.32	635.68	626.49
May 15, 1998	636.67	636.12	634.18	625.69
May 22, 1998	636.07	635.52	634.38	633.19
May 29, 1998	636.07	635.32	634.78	628.99
June 5, 1998	635.47	635.02	634.28	626.19
June 12, 1998	635.47	635.32	634.58	628.89
June 19, 1998	635.47	635.62	635.18	631.69
June 26, 1998	635.57	635.32	635.08	634.29
July 2, 1998	635.07	635.12	635.18	627.89

These levels indicate that over time, the levels inside the barrier wall have decreased, as a result of pumping from the BWES. This decrease in levels is depicted graphically on Figure 4.1. P96 is in close proximity to BWES extraction trench EW-11, and therefore fluctuates with the operation of the pump in EW-11. Over time, however, the levels at the "peaks" on Figure 1 show a decreasing trend, indicating that the BWES pumping is having the desired effect of reducing the water table elevations within the barrier wall.

The influence of the PGCS trench on groundwater flow patterns is illustrated by Figures 4.2 (December 1997), and 3 (June 1998). The direction of groundwater flow was from east to west during these months. These figures indicate an inward gradient toward the PGCS.

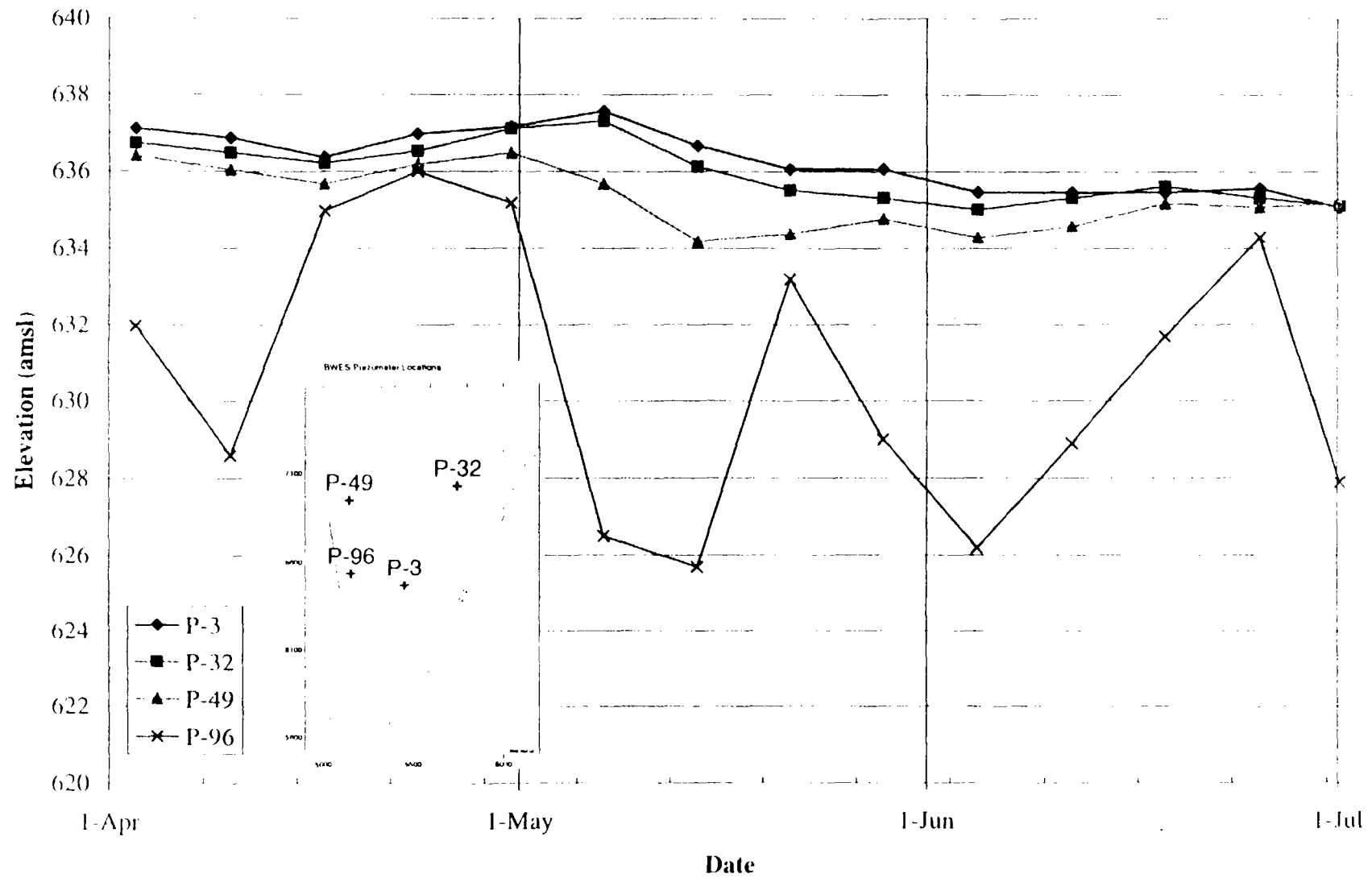
The barrier wall was constructed to isolate a highly contaminated zone and the BWES was installed to collect the contaminated water within the barrier wall. A series of 16 piezometers was installed in eight pairs, one piezometer of each pair on either side of the barrier wall at each of the BWES trench locations, to allow measurement and tracking of water level measurements. In order to ensure that the barrier wall was serving its design function, groundwater elevations in these piezometers both inside and outside the barrier wall are monitored.

Groundwater elevations inside and outside the barrier wall were monitored on December 8, 1997, March 30, 1998 and June 1, 1998. Figures 4.4 ,4.5 and 4.6, respectively illustrate these groundwater elevations. Fluctuations in the gradient across the barrier wall occur due to seasonal groundwater conditions, pumping rates from the BWES, and infiltration through the Site covers. However, the groundwater elevations measured in the piezometers indicated that the elevations inside the barrier wall were up to six-and-a-half feet higher than those outside the barrier wall. These data clearly demonstrate that the barrier wall is successfully performing the intended function of isolating and containing the groundwater from the known source areas of the Site inside the barrier wall.

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Water Levels Inside Barrier Wall



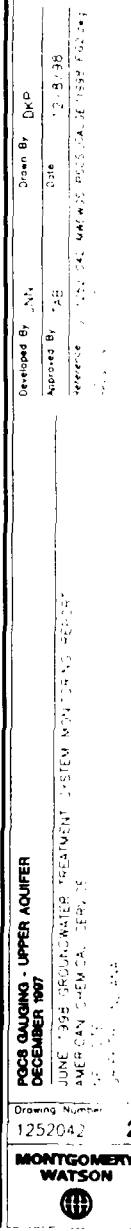
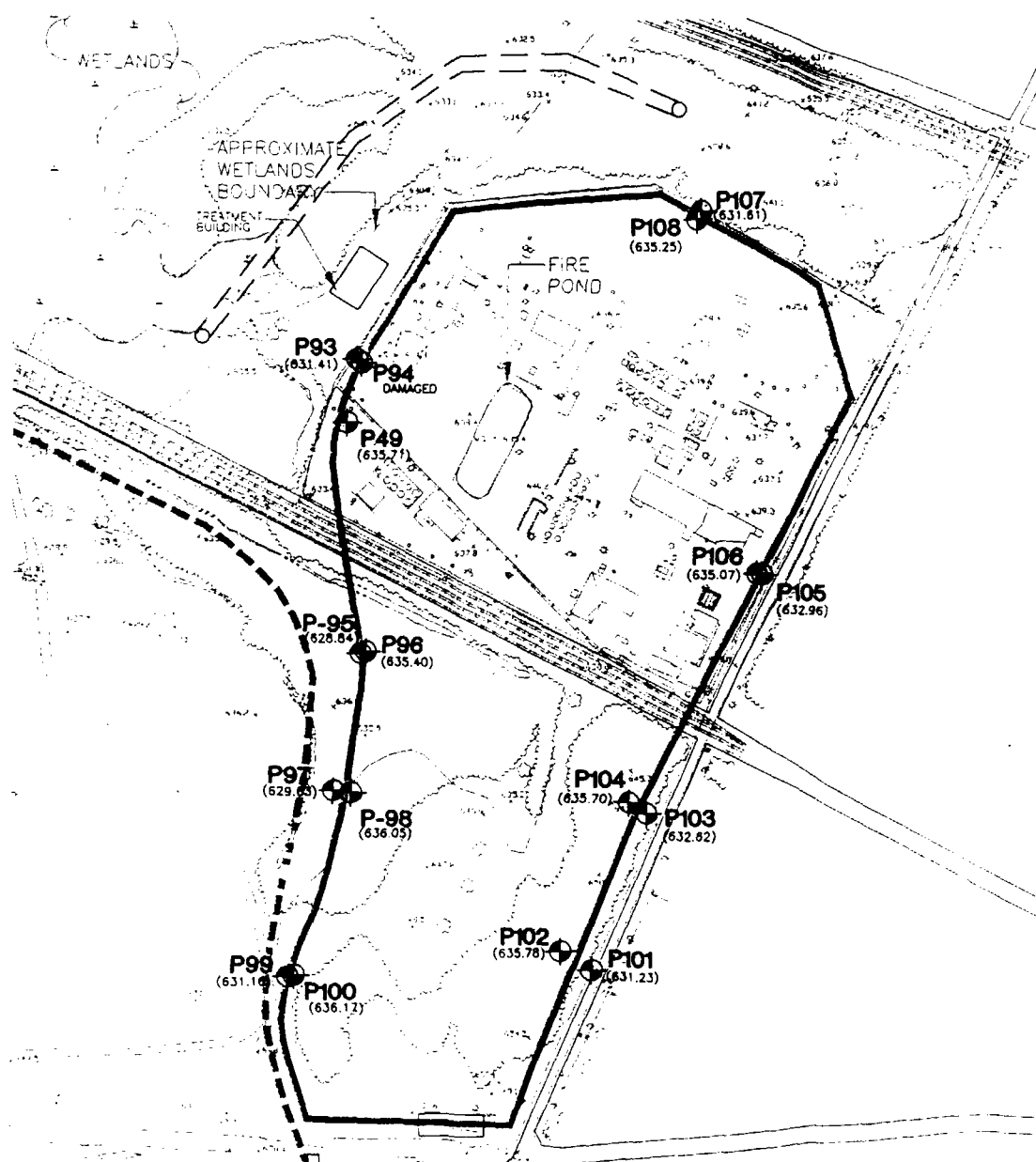







FIGURE 4.2



LEGEND

-  P108
(635.25) PIEZOMETER LOCATION AND DESIGNATION
-  (635.12) ELEVATION
-  BARRIER WALL
-  GRIFFITH LANDFILL BOUNDARY
-  PERIMETER GROUND WATER CONTAINMENT SYSTEM

NOTES

1. GROUNDWATER ELEVATIONS WERE MEASURED AT THE SITE ON DECEMBER 8, 1997.

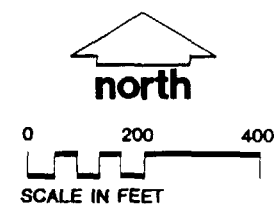


FIGURE 4.4

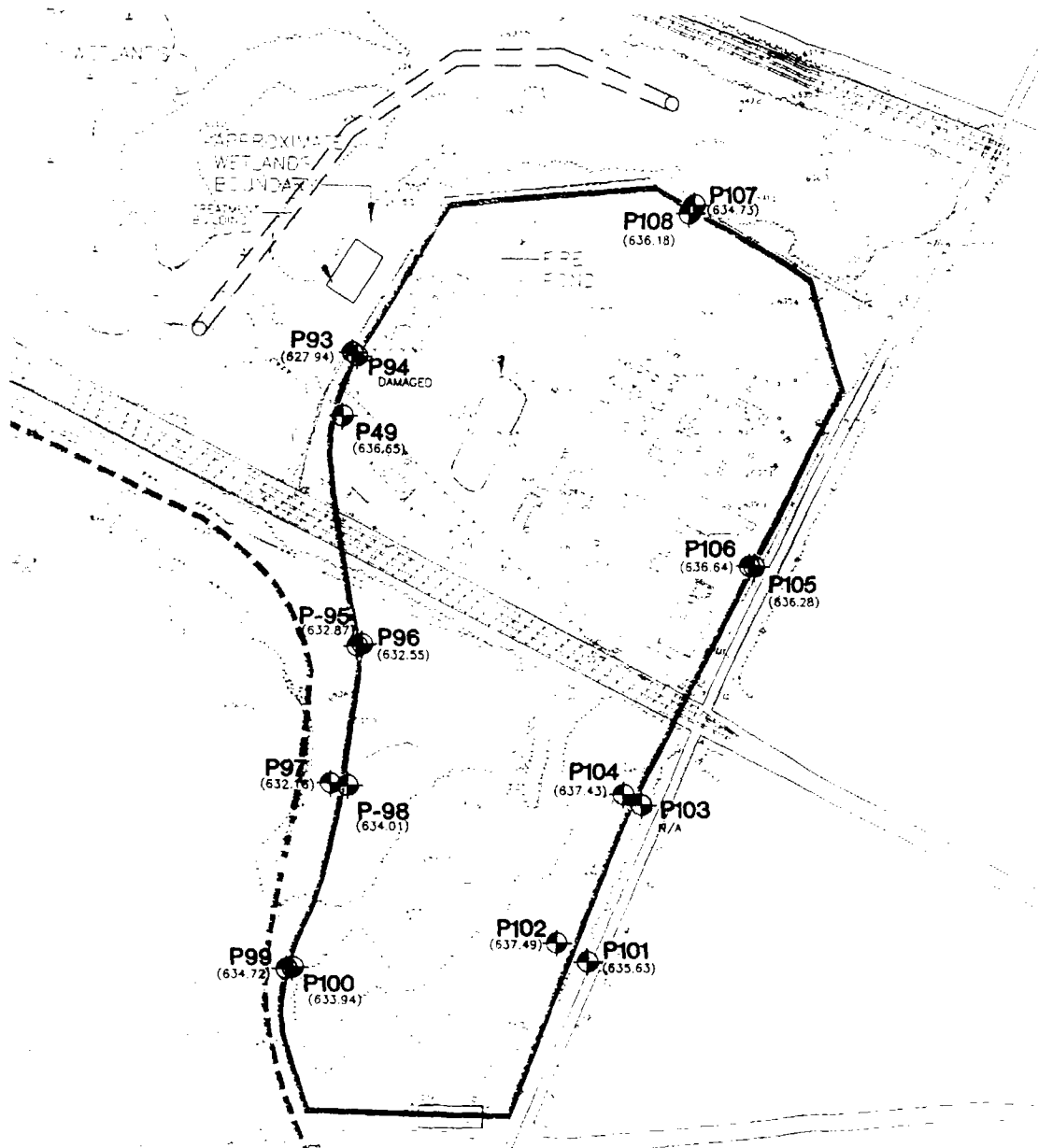
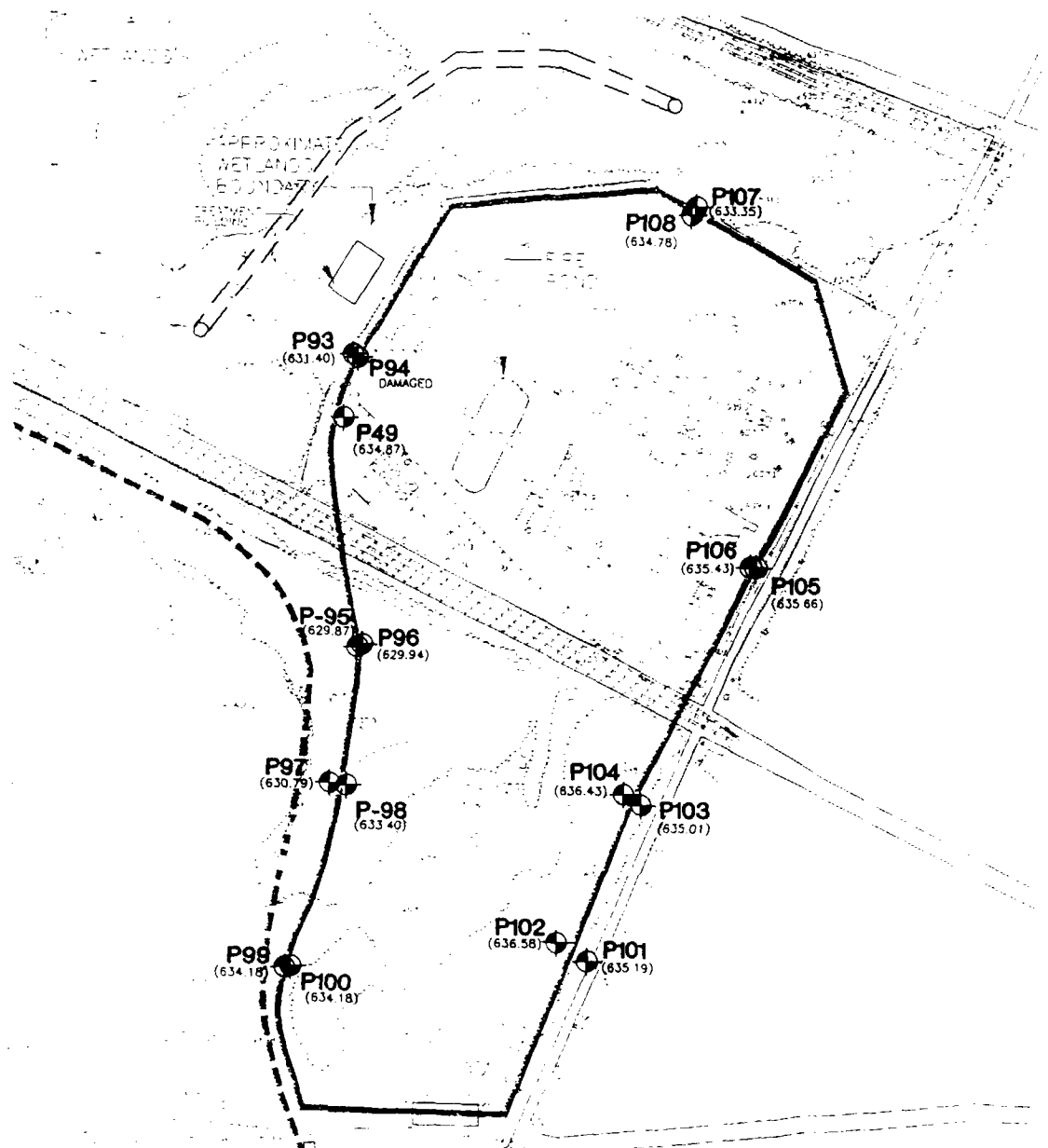


FIGURE 4.5



LEGEND

- P108
 (638.12) PIEZOMETER LOCATION AND DESIGNATION
- ELEVATION
- BARRIER WALL
- GRIFFITH LANDFILL BOUNDARY
- PERIMETER GROUND WATER CONTAINMENT SYSTEM

NOTES

- GROUNDWATER ELEVATIONS WERE MEASURED AT THE SITE ON JUNE 1, 1998.

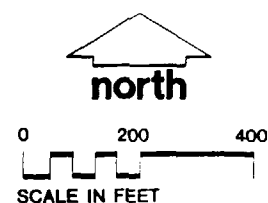


FIGURE 4.8